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KOLA NUTS

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Historical Development of the Kola Nut Industry

Kola seed kernels, popularly called kela nuts, have been credited from time immemorial with extraordinary properties by the African aberiginal races populating the vast extent of territory between French Sudan to the north, and Angola to the south of the equator. (1)* They were probably first noted in the account of the travels of Lee Africanus, who explored a large portion of Central Africa during the early years of the sixteenth century. (2) In speaking of the country through which he passed, he stated that no trees of any kind were found except one variety of great size which bore bitter fruit, called by the inhabitants Gore, or Guro.

Fileppo Pigafetta quoted the Portugese explorer Odoardo Lopez, as having been the first to give an exact description of the fruit and seed of the kola. (3) The translation from Lopez states: "The fruits are as large as fir-cones and have an interior similar to our chestnuts in which there are four seeds red and flesh-red. (4) If held in the mouth or chewed they will quench thirst, they are agreeable to the stomach and are beneficial to the liver."

C. Clusius described the kola nuts and was prebably the first to furnish illustrations of them. (5) He described the fruit of the kola as being as hard as stone when dried . . . " He also stated that the inhabitants of Cape Verde always used them when fasting and that they were able to abstain from food for a whole day after having eaten three of four.

Abbe Prevost, in L' Histoire Generale des Voyages assembled information from various explorers regarding kela nuts. (6) He quoted Fuich, who explored Sierra Leone in 1607 as having reported that kela nuts were used as money in some of the kela producing countries or among tribes which had no other currency.

The first comprehensive and probably most authentic early description of the native uses of kela was furnished by the betanist Palisot de Beauvois. (7) Among other things he wrote that the negroes of Oware (probably Owerri, a province of Nigeria) ate the nuts because of their reputed power of giving to all food and drink, even brakish water, a pleasant taste.

Figures in parenthesis refer to literature cited at end of text.

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Mr. Chas Barter, Natural History Collector of the British Nigerian Expedition, 1859, distinguished between two kinds of kela; one with four cotyledons, called "Fatak" by the native tribe of Foulahs, and another with two cotyledons, called "Gonja" by the same people. (8) The two cotyledon variety was reported the more highly prized.

Dr. Daniell, who resided in West Africa for some time, prefaced a discourse which he delivered before the Pharmaceutical Society of Great Britain in 1865, by mying that it would be futile to attempt the discovery throughout the vegetable kingdom of tropical West Africa of any analogous product that occupied such an exalted position in the social or distetic economy of the negro tribes or constituted such an important article of commerce in Soudan as the seeds of the kela tree. (1) (9)

From a dispatch transmitted by the Marquis of Salisbury from the British Consul at Bahia, Brazil, in 1890, containing a report of the properties and uses of kola, the following is extracted: "The West African carriers at this port who use kola ... are, as a whole, not, physically superior to the Brazilian negro, and yet the African through constantly masticating kola can endure labor and fatigue which no Brazilian carrier can withstand, and where, for instance, it takes eight Brazilian negroes to carry a load with difficulty, four African porters carry it cheerfully, almost always, even though ascending a hill, singing and chanting the whole time as they trudge along (1) I have myself had a bag of sugar weighing 80 kilos (179 pounds, English) refused by a young, healthy, able-bodied, native porter who could not so much as move it, carried away with ease by an aged African negro after biting a piece of kola nut and transported a distance of four miles without once taking it off the head."

Kola nuts are important in the social, political and religious life of the natives. In some tribes, a young man's offer of marriage is accompanied by one or more white kela seeds sent to the mother of the girl of his choice. The return of a white kola seed to the young man signifies acceptance of his offer of marriage while a red kola seed returned indicates rejection. No marriage gift of the bridegroom to the father of the bride would be acceptable without a goodly number of kola seeds. Presentation of kola seeds to a white trader or native personage of high rank visiting any native chief constitutes the highest compliment that can be paid. The gift of a few kola seeds on the departure of a guest expresses the farewell good wishes of the host. Upon death of a member of the native tribes, a quantity of kola seeds sufficient to nourish the deceased on his long journey is placed in the grave. Among the Mohammedans, kola is regarded as a fruit of divine origin, introduced by the prophet himself and intended to drive out the evil spirit, expel disease and prevent plagues.

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Explorers of the "Dark Continent" from the middle of the sixteenth century to the present time have given vivid descriptions of the tree and its fruit and the remarkable properties attributed to it by the natives. Among the more eminent African explorers who have written upon this subject are: Rene Caillie (a), Schweinfurth (b) and Griffon du Bellay (c). It would be easy to multiply quotations showing the exalted position held by this commedity as an article of consumption among the natives of West Africa. As a tenic and stimulant, it has attracted the attention of travelers and explorers, who generally mention, at least incidentally, its virtues. Some of these notices, however, are manifestly extravagant.

Among botanists who have, one after the other, studied and described the history, structure, functions, and environment of the kela trees and their products, the following may be mentioned: Bosc (d), Stokes (e), Bory de Saint-Vincent (f), Schott and Endlicher (g), Merat et de Lens (h), Virey (i), Thiebeaud de Berneaud (j), Baillon (k), Brown (1), Palisot de Beauveis (m).

Despite these reports and writings no apparent interest was indicated in the use of kola nuts in Europe. In 1883, however, the monograph on kola seeds by Heckel and Schlagenhauffen appeared. (n) It was, in reality, at this time that European attention was directed to the therapeutic properties of kola.

In America, a brief notice of kela appeared in the American Journal of Pharmacy in the year 1857 p. 181 and another in 1880 p. 617. The scientific department of Frederick Stearns & Company, offered kela for sale in the United States in 1881 and it is claimed that this was its first introduction into the commerce of the United States. (1) In the monograph published by this firm in 1894, the company laid claim to being at that time the only importers of kela nuts in their fresh, undried state. These nuts were frequently exhibited before scientific bedies and were offered free to physicians for experimental plantings.

- (a) Journal d'un voyage à Tombouctou et à Jenne 1825.
- (b) Au cocur de L'Afrique, 1875
- (c) Au Gabon (in) Tour de monde, 1868
- (d) Nouveau Dictionnaire D'histoire naturelle appliquee aux arts, a L'agriculture et l'économie rurale et domestique, etc., 1803.
- (e) Bot. Mat. Med., ii 564, 1812
- (f) Dictionnaire classique d'histoire naturelle, 1823
- (g) Meletem, 33, 1832
- (h) Dictionnaire universel de matiere medicale, 1829
- (i) Journ. de Pharm. et de Chimie, 1827 and 1832
- (j) Dictionnaire pittoresque d'historie naturelle et des phénomenes de la nature 1839
- (k) Histoire de plantes, 1879
- (1) Botany of Congo, 1818
- (m) Flore d'Oware et Benin., XXIV, 1807
- (n) Sur les Kolas Africans, 1883

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The Kola Tree, Description, Classification (Species - varieties)

The kola tree belongs to the very large family Sterculiaceae which contains several hundreds of known species of these plants distributed throughout the tropical regions of the world. (4) Among these plants, the genus Theebroma (Cacaoyer) and the genus Cola are the two of greatest economic importance.

Botanists differ somewhat in classification of the varieties and types of cola and as to which species provides the bulk of the kela nuts of commerce. One of the most comprehensive studies of the kela is that of August Chevalier and Em. Perret. (4) This reviews and summarizes much of the rather extensive literature previously published on kela nuts and incorporates additional information obtained through study and exploration of much of the kela producing regions in the western and central part of Africa. This study involved travel of more than 9,000 miles through these regions begun in 1899 and extended intermittently into 1910.

The kola tree is described as a large and beautiful tree resembling in appearance the chestnut. It attains a height of 25 to 45 feet at maturity and in exceptional cases in the interior of the tropical forests some 65 to 75 feet. The trunk is smooth and cylindrical measuring some 2 feet in diameter and from 10 to 20 feet long often forking at about the middle of its height with branches spreading out or extending upward. (Fig. 1)

The leaves are large, smooth, numerous and may be alternate, opposite, or whorled, long petioled, (1 to 3 inches long), entire margined, 3 to 6 inches long and 1 to 2 inches broad. The petioles (stems) are slightly thickened at the base. The flowers, perfect or unisexual are borne in axillary inflorescences, sometimes subterminal.

Some trees produce exclusively unisexual flowers while others have perfect and unisexual flowers intermingled. In no instance have trees bearing perfect flowers alone been reported. The two types of flowers are readily distinguishable from one another, the unisexual flowers being smaller and rotate while the perfect flowers are ampanulate (bell-shaped) and larger. The calyx which is valvate in both cases, forms a small nearly globular and at first a white downy bud. The calyx is usually five cleft and there are no petals. The flower stalks measure from 1 to 2 inches and merge into the calyx. The calyx measures from 2 to 12 inches across and varies in color from cream-white to yellowish with 15 well-marked purple or blackish veins (3 to each lobe of the calyx) extending from the base to half-way the length of the limb or lobe. Some very rare species have pure, white flowers without the colored veins. The flowers are slightly fragrant having an oder like vanilla and upon drying some-what like that of aprient.

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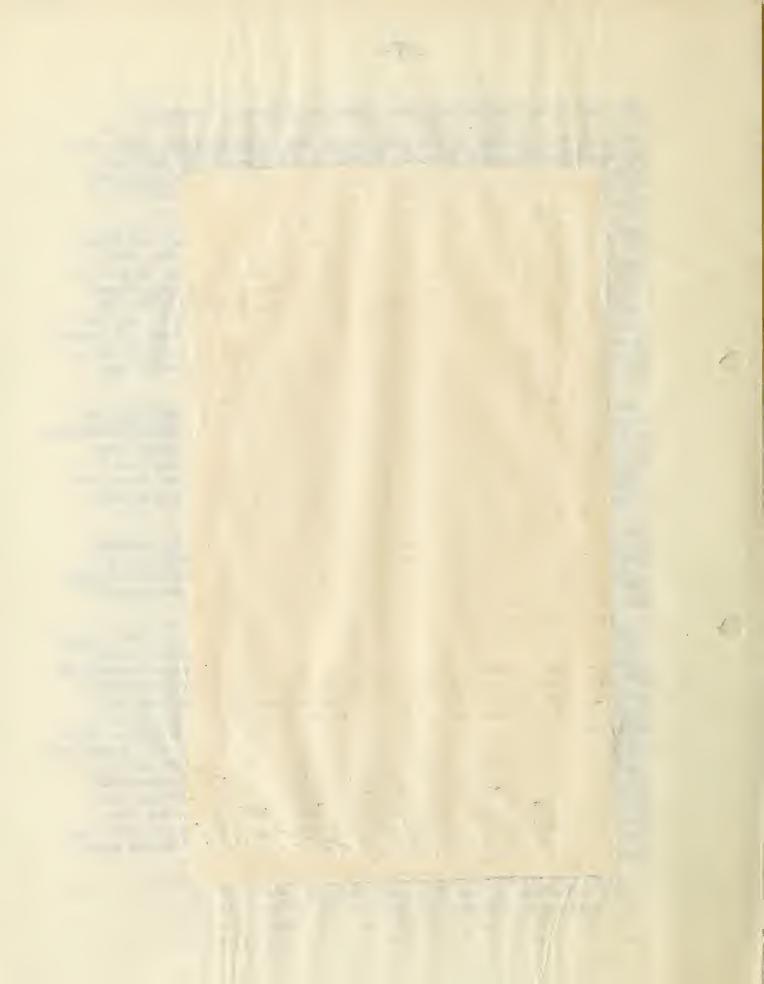


Fig. 3. — Arbre a Kola tola acuminata R. Brown du jardin bolamque de Sant Pierra Martinique. — Avant le cyclone du 18 août 1824.

Fig. 1-Zela troc (Cola acuminata R. Brown du jardin bolamque de Sant Pierra Martinique. — Avant le cyclone du 18 août 1824.

Fig. 3. — Arbre a Kola tola acuminata R. Brown du jardin bolamque de Sant Pierra Martinique.

in the botanical garden, Saint Pierre, Martinique.
Before the cyclene, August 18, 1891. Hookel, E.,
Les Kolse Africaine, P. 41.



The fruit of the kola tree varies with the varieties or species. The mature fruit normally consists of from 1 to 5 eblong or ellipsoidal, rather thick and woody seed pods, chocolate brown in color with a smooth surface, sometimes constricted at one or more places, from 3 to 6 inches long and from 2 to 3 inches broad. (Fig. 2) The cells of the outer layers are cubical and filled with a brownish, resincus, coloring matter. Directly beneath this tissue, the walls become thinner and more delicate and enclosed in this tissue are large air spaces, which, at an early period of development, probably contain mucilage. Gradually the cells become larger, clongated and more compact. In this tissue the spiral vessels are embedded. Calcium oxalate crystals are found scattered throughout the entire tissue. When the fruit matures, the pods split along the under side, and the seeds containing the kernels, which are the kola nuts of commerce can be harvested.

Each fully matured pod contains from 1 to 10 seeds, in which are enclosed from 2 to 5 or more kernels or "kola nuts." The seeds resemble in appearance the common horse-chestnut, being tightly nested in the pods and having an irregularly angular shape resulting from compression against the sides of the peds during the process of development. (Fig. 3) The seed coats are somewhat purplish and cartilaginous and these are removed before the kola muts are offered for sale in the markets. In all types and varieties of the kernels examined, the kernels were enclosed in a whitish, spongy tissue which may be from 1 to 12 inches thick and easily removed by scraping. Two parts of this tissue are clearly distinguished, a thin skin surrounding the embryo or kernel without being attached to it. the interior surface of which is covered with det-like depressions and which is the internal tegument (skin) of the seed and a thicker, spongy external layer surrounding the whole seed, very smooth on the surface and which appears to be a continuation of the wall of the pod but is, in the opinion of the author, Chevalier(1) an external membrane enveloping the entire seed. It may be added that this same external tegument hardens and in certain species of the genus cola becomes aweet enough to be edible.

The number and physical characteristics of the kernels vary among the different species and varieties and these differences are significant in the botannical classification of the trees as well as in the commercial value of the products. The kernels are rather thick and fleshy. A transverse section of one of the kernels of a fresh seed shows an spidermal layer of very regular, thick-walled, empty cells. The outer surface is somewhat convex and amber brown in color. Immediately beneath the epidermal layer, is the fundamental tissue which comprises the whole of the fleshy portion of the kernel. This tissue is composed of large angular cells with thick walls and very plainly marked intercellular spaces. Occasionally, a delicate spiral vessel is also found. Each cell is well filled with starch which very much resembles the common potato starch in appearance. The grains are ovate, possess a distinct hilum at one end which is surrounded by very plainly visible eccentric rings. A section of the kernel heated to dryness with potassium chlorate and hydrochloric acid and then exposed to the fumes of amaonia gas, shows the Murexoin test for caffeine. The kernels, in general, have an agreeable although somewhat bitter taste becoming sweet when mixed with saliva.

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Schlotterbeck, J. O., Kola Pharmacognosy, Part I., Kola, Frederick Stearns & Co., Detroit, Michigan, 1894.





Schlotterbeck, J. O., Kola Pharmacognosy, Part I, Kola, Frederick Stearns & Co., Detroit, Michigan, 1894

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Chevalier classifies all of the known species of kola trees into 2 main groups dependent upon the number of kernels in the seeds. The first group designated as the Cola nitida is the species providing the most highly prized kola nuts of commerce. The distinguishing feature of this group is that all of the seeds contain only 2 kernels. Under this general classification, the author lists 4 sub-species or varieties. These sub-species are: 1. Cola rubra, from trees producing exclusively red kernels; 2. Cola alba, from trees producing exclusively white nuts; 3. Cola mixta, from trees producing both red and white and sometimes light-red nuts, which the author suggests may be a hybrid of the cola rubra and cola alba; and 4. Cola pallida, from trees producing small light red or white nuts or nuts of light red mixtures. All of these sub-species or varieties are today well known.

Under the second group of Chevalier's classification are the species having more than 2 kernels in the seeds. This second main group is again broken into sub-groups classified according to the shape of the pods, the first sub-group including trees having oblong or elongated fruit pods with a very prominent dorsal crest. This group includes: 1. cola acuminata (Schott and Endlicher), also characterized by having alternate leaves; 2. (cola verticillata (Stapf) characterized by whorled leaves in groups of 3 or 4, rarely opposite one another; 3. (cola Ballayi (M. Connu) having irregularly whorled leaves in groups of 5 to 15. The second sub-group contains only the species Cola sphaericarpa (A. Chevalier) distinguished by nearly spherical pods, much like a closed fist.

Environmental Requirements, Cultivation, Yields

The kola tree flourishes in moist, tropical climates at or a little above sea-level. (1) Some beautiful specimens have been found on the coast of Sierra Leone at altitudes of 650 to 1,000 feet. The colas require a rich, well-drained soil. (11) Those introduced into the West Indies and into other parts of America, especially the Cola acuminata, thrive best on a sandy loam. The trees are grown from seeds. As the tree is somewhat difficult to transplant, the seeds may be planted in pots and the young trees kept growing thus until the time for permanent planting. Propagation may also be effected by mature cuttings. Cultivation of the trees is not difficult and they have been successfully introduced into many of the French, English and former German colonies and possessions as well as into certain countries of the Americas.

The tree begins to bear fruit in the fourth to the sixth year but the maximum yield is not obtained until the ninth or tenth year when as much as 125 pounds of nuts may be obtained annually from each tree.

One feature of the tree is that it blossoms and bears fruit simultaneously having both flowers and fruits throughout the entire year. Despite this fact, there are only two harvests each year. The main harvest in African countries occurs in October and November from the June flowering and the second occurs in May and June from the November flowering.

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Mr. F. W. Fawcett, F. L. S. (12) speaking from his experience in Jamaica, states: "The kola tree is propagated from seeds and will begin to bear fruit after five or six years. There are trees near the Bentannical Garden, Castleton, which were planted over fifty years ago, still in perfect health and bearing fruit regularly. The trees should be planted about 20 feet apart, which could give about 108 trees to the acre Those near Castleton produce from 500 to 800 peds each crop. If each ped contains on a moderate calculation 4 seeds, and if we say 50 seeds to the quart, then a tree producing 600 peds will give 50 quarts of nuts twice a year, or 100 quarts per tree per year. A quart of dry nuts will weigh a little over 14 pounds, or 125 pounds a tree. A tree in full bearing and under careful cultivation would probably produce 150 pounds of nuts a year."

James Neish reports that the kola tree adapts itself to a wide range of both soil and climate. (13) It can be grown in all hot and seasonable areas having a rainfall of 80 inches or more, and produced wherever bananas are produced. It is suggested that kola plantations can very well be established along with banana plantations at little additional cost. After bananas are harvested, the fields may be cleaned and planted to catch-crops such as leguminous plants which may be used as a mulching for the kolas or turned in green, as manure. While kola trees produce rather abundantly in their natural habitat without cultivation, yields on plantations may be increased by proper tillage and enrichment of soil.

Geographic Distribution, Species and Varieties

The Cola nitida is unquestionably indigenous to the virgin forests of the Ivory Coast and of Liberia between parallels 50 and 70 North latitude. The numerous varieties and types of this species are also cultivated in the Ivery Coast, Liberia, French Guinea, Sierra Leone, the Gold Coast, Nigeria and Toge. It is also grown by Europeans in large plantations in Togo, Dahomey, Cameroon and French Equatorial Africa and in Liberia in the region around Lagos. The sub-species or variety Cola rubra is abundant in the northwest of the forests of the Ivory Coast and in the interior of the forests and is the only type produced in the Achanti (northern) region of the Gold Coast. It is also produced on plantations in French Guines around Kissi and in the countries of Tomas and Manons (regions of Lola). Cola alba is produced principally in French Guinea and in the Ivory Coast. Cola mixta is the predominant variety in French West Africa. Cola pallida is found in the Ivory Coast and in the interior of the forests, particularly in the central portions of Sassandra, Cavally and in the central part of Comoe.

Cola acuminata is cultivated in the Ivory Coast although Cola nitida predominates here. It is also found in Togo, Lower Dahomey, Nigeria, Cameroon, and French Equatorial Africa and in the islands of Sao Thome and Fernando-Po.

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Cola verticillata is produced principally in the Gold Coast, Lower Dahomey, and in the south of Nigeria between Lagos and the frontiers of Dahomey.

Cola Ballayi is found mainly in French Equatorial Africa and in the Belgian Congo.

Cola sphaerocarpa is found in the center of the Isle of Sao Thome and in the virgin forest between San Pedro and Lagua Amelia.

Collection and Harvesting

When the kola seed pods are ripe, as indicated by their turning a chocolate brown color and splitting along the under side, the seeds are exposed and harvesting and collection of the kernels can begin. As many as 5 carpels or seed pods may result from a single flower.

The kernels bruise easily. Discoloration soon begins at the injured place and decay and mold progress rapidly. Thus collection and packing consequently require delicate handling. The gathering of the nuts is usually done by native women who have acquired considerable skill and dexterity in removing the seeds from the pods and cutting off the seed coat, leaving only the bare, uninjured kernel. Extreme care is also required in selection of good quality nuts for long distance transportation and in the preparation for shipment.

In Jamaica, as the seed pods open on the trees, the nuts are picked and the yellowish green kernels removed from the enclosing membranes. (14) The kernels are then cut into two sections to prevent rotting and formation of white centers or molding. The kernels are then placed on a coffee barbeque for sun drying, although some are dried by artificial heat. The dried nuts are dark brown in color and as hard as stone when they are ready for shipping.

Kernel Characteristics

Kernels of the Cola rubra are of a dark red at maturity, taking before complete development a cerise or carmine red tint. The flesh of the kernels is also red and non-mucilaginous. The weight of the kernels ranges from 7 to 100 grams with the average between 10 and 25 grams. (From \frac{1}{2} to 1 oz.)

Nuts of the Cola alba are large of a snow-white color when separated from the surrounding membrane but after some time, turning a dirty white or pale yellow. The flesh of these kernels is white, non-muscilaginous, and takes a yellow tinge when broken or exposed to the air. The flavor of these nuts is somewhat milder than that of either the Cola rubra or the Cola mixta. The weight of these kernels averages from 25 to 30 grams. (About 1 os.)

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No definite distinguishing characteristics as to the size of coloring of the Cola mixta are given. The author observes, however, that in the Cola mixta the red nuts are in general in the proportion of 2 to 3 or 3 to 4 the white nuts or the red forming the third or fourth. These preportions of coloring approach those indicated in mendel's law of the second generation. (Through which the hybrid of the second generation of a cross between plants of pure white and pure red flowers would produce \$\frac{1}{2}\$ pure white flowers, \$\frac{1}{2}\$ pure red flowers and \$\frac{1}{2}\$ pink flowers) It is to be observed that in accordance with this law some of the trees of this sub-species produce only white nuts, some produce exclusively red nuts while in others the red and white nuts are found together in the single seed.

The kernels of Cola pallida are ordinarily light red in color although senetimes as red as the Cola rubra but always smaller and having a bright red tinge before maturity. (4) The flesh is also a bright red or deep red. Sometimes a mixture of small white nuts or yellowish green nuts are found in the fresh state. The nuts when broken take a yellowish tinge. The weight varies from 3 to 12 grams. The flavor is pleasant but these nuts are not well liked by the African natives of the Sudan.

Kernels of the Cola acuminata are egg-shaped or somewhat polyhedrical as a result of compression in the pods. They weigh from 5 to 50 grams and sometimes measure 3 to 4 cm in diameter. The flesh is white to light red taking a violet tint when bruised and then turning brown. The flavor of these nuts is said to be agreeable but the kernels are somewhat mucilaginous and less desirable than the kernels of the cola nitida.

Cola verticillata kernels are of a reddish wine color, having 3 to 5 kernels to the seed of which one kernel is often much shorter (sometimes less than half as long) than the others. The flesh of the kernel is also bright red taking a violet tinge as soon as broken and then turning a brown ochre (brun-corace) with a white border on the outside edge of the kernel. Fresh kernels when not completely ripe have a flavor similar to that of the cola nitida not ripe. It is a little bitter but leaves an agreeable flavor in the mouth. Some of the natives chew these nuts when they are available but they are considered of little commercial value and are never sold in the markets.

The <u>Cola Ballayi</u> kernels are red with a white border visible around the edge of the kernel. They are largely egg-shaped attaining in some instances a length of 3.5 cm and a breadth of 2.5 cm. in diameter usually appearing as 4 to 6 kernels in a seed somewhat unequal in size with each kernel having a median split in the lower third of the kernel. The flesh of the kernel is red, turning to violet as soon as broken and then in about 2 minutes taking a tinge of russet brown or yellowish red near the faces of contact of the kernels.

The Cola sphaerocarpa kernels are white becoming brown when dry. They appear as 4 to 5 kernels of unequal size in the ped and are inedible.

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Chemical Analysis of Kola Nuts

Early English analyses of kola muts showed the calculation of the total alkaloids as theine, the existence of theobromine in kola not having been established at that time. (15) It was considered somewhat remarkable that no tannin was shown in these early analyses, since a watery decoction will give at once the characteristic color reactions upon the addition of a test solution of iron.

Satisfied that the analyses by English chemists were subject to question, Messrs. Heckel and Schlagdenhauffen applied more modern analytical methods, described in detail in their monograph, and obtained the following results:

Table 1.-Composition of Kola Nuts

Compenent	Percentages of Total Weight			
	Percent	Percent		
affeins	2.346) Soluble in	(
heobranine	0.023) chloroform	(
annin	0.027)	(2,983		
atty body	0.585			
annin	1.591) Soluble	(
Iola red	1.290) in	(5.826		
lucose	2.875) alcohol	(
ixed salts	0.070	·		
starch	33.754	33.754		
ium .	3.040	3.040		
oloring Matter	2.561	2.561		
rotein	6.761	6.761		
sh	3.325	3.325		
loisture	11.919	11.919		
Cellulose 1/	29.831	29.831		
Total 2/	100.00	100.00		

Heckel and Schlagdenhauffen, Les clas Africains, Societe d'Editions Scientifiques Paris

^{1/} By difference

^{2/} Totals as given in original. Items do not add to totals.

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Mutritive Value of Kola Compared with Cocoa, Tea, Coffee

Kola nuts are primarily used in the European and North American countries as flavoring or for the stimulating effect of their alkaloid contents. Their use when dried as a food by the African natives, however, justifies some consideration of the nutritive value as indicated by the proportion of the principal food.constituents. The principal costituents of kola nuts and certain other products are shown in the following tabulation of chemical analyses:

Table 2 .- Principal Constituents: Kola Nuts, Tea, Coffee, Cocoa

2	Kola (Heckle &	*	: Tea	3	: Cocoa
	Schlagden-	2	(Peligot)	; Coffee	: (Mitscher-
Constituents:		: Green	: Black	: (Payen)	: lich)
	Percent	Percent	Percent	Percent	Percent
Fat	0.585	0.28		13.00	53.00
rotein	6.761	3.00	2.80	13.00	13.00
Cheobromine	0.023	3,00		22300	1.5
Caffeine	2.348	0.43	0.46	2.25	
Essential Oil	1/	0.79	0,60	0.003	0.40
Resin	2	2.22	3.64		
ugar	2.875				0.50
Starch	33.754			15.50	
Gum	3.040	8.58	7.28		
Cellulose	29.831	17.08	26,18	34.00	
Color matter	2.561	17.24	19.20		
Celoring matte		3/ 2.22	3/ 1.84		4/ 5.00
extrative	and .	22.80	19.88		and .
famin	1.618	17.80	12.88		
Ash	3.395	5.46	5.24	6.697	3.60
Moisture	11.909			12.000	6.00
Total	100 .000	100.000	100.000	100.000	100.000

Compiled from data of Heckle, Edouard, Les Kolas Africains, Societe d'Editions Scientifiques, Paris, 1893, p. 206 (

^{1/} Non-determined

^{2/} Kola red 3/ Chlorophyll 4/ Cocoa red

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Since these products are used in Europe and America largely as stimulants and tonics, the alkaloid content is the most important constituent in relation to its physiological effect. It is to be noted that the alkaloid content of kola nuts is greater than that of coffee, considerably more than that of cocoa and nearly 4 times that of tea. Kola nuts contain considerably more of the alkaloid caffeine, which is the important stimulating principle, than either tea or coffee, and, in addition, contain an appreciable quantity of theobromine which tends to intensify the action of the caffeine and may also be converted to caffeine by methylation. In comparison with cocoa which contains only theobromine, kola contains less theobromine but since in addition it contains caffeine the total alkaloid content is nearly 60 percent greater than that of cocoa.

Besides these stimulants, kola has an additional glucosoidal principle known as kolanin, which is peculiar to kola alone. Claims have been made that it is to this principle that the superior action of kola is due but these have not yet been proved.

Grades, Technical and National Formulary

Kola nuts sold in the commerce of the United States are seld on the basis of the usual trade technical grades, designated as choice, prime quality, etc., or through descriptive terms or designations indicating the type of nuts or country of origin. In some instances certain other grading factors are indicated such as "washed" nuts. Except for these there is only one grade standard which is simply "good, merchantable quality" of sound, well-dried nuts.

The standard/quality and grade for the drug trade products, prepared by the Committee on the National Formulary by authority of the American Pharmaceutical Association (17) follows:

"Kola is the dried cotyledon of Kola Nitida (Ventenant) Schott and Endlicher, or of other species of Kola (Fam. Stereculiacea).

"Kola contains not more than 1 percent of foreign organic matter, and yields not more than 0.5 percent of acid-insoluble ash and not less than 1 percent anhydrous caffeine.

"Unground Kola-Irregularly plano-convex or somewhat globular, and from 2.5 to 5.00 cm in length; heavy, hard and tough; reddish black to light brown, smooth or somewhat wrinkled; edges slightly incurved and sharp.

"Powdered Kola - Color, light brown to moderate yellowish brown, odorless, taste, mildly astringent; numerous starch grains, some of which show alteration, the normal grains up to 45 microns in

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"diameter, the smaller ellipsoidal or spherical, the larger ellipsoidal or irregularly oblong and occasionally with a protuberance on one side, many of the larger grains show lamellae and a circular hilum or fissure through the center; parenchyma cells numerous, about 65 microns in diameter."

Local Names of Species and Varieties (4)

Cole rubra kernels are locally known as the red kela, nuts of Gonja, the kela of Achanti (Colons), or Gonja (in Nigeria).

Cola alba kernels are called the white kela of Anno.

Cola mixta has no distinctive name.

Cola pallida kernels are known as Oua na (Abe) and also as kola du sanglier (or du potamochere) (a) because of the color of the nuts.

Cola acuminata kernels and called the kola of 4 to 5 lobes, Little Kela of Dahomey, Kela of Gabon (Colons) Hobi (mago) Guiti (Dahomey) Kela male (Dahomey) Abata Kela (Lagos), Fatak (migeria) Cabene (mpongoue) Abel (pahouin)

Cola verticillata kernels are known as: Kola of water (Colons).
(It is probably le wasser Kola due Togo Abidab (nago). Not to be confounded or confused with Abidoum with us the name of the kernel of Carapa procera of Dahomey. Holovi (Dahomey) literally kela mucilaginous.

Cola ballayi kernels are called kola of Cubangui (colons) Laberou (Easindji d'Impfondo.

Cola sphaerocarpa kernels have no specific local names.

Frincipal Uses and Substitutes

The principal uses of kola nuts in Europe and America are as a source of caffeine in the drug and pharmaceutical trade and as a flavoring and stimulant in soft drinks and, to a limited extent, in baby foods and malt extract.

⁽a) Literally translated means "kola nuts of the wild bear". Frobably refers to the Red River Wog, "Potamocheerus percus", or "painted pig" so-called from its vivid, red-gold coat, long black ears and grotesquely marked face.

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It is estimated that of the million pounds of kola nuts normally imported into the United States, approximately 10 percent represents the quantity required for medicinal uses. (10) The caffeine content and to a lesser extent the theobromine, make the kola nut valuable as a diructic, cardiac, respiratory, vasomotor, reflex and psychic stimulant. Approximately 90 percent of the United States imports are utilized in various beverage preparations such as kola-wine, kola-chocolate, and "Cola" drinks for the flavoring and for the mild stimulating effects and in preparations of baby foods and malt extract. Where kola nuts are used primarily for flavoring, no acceptable substitute has been developed.

Other sources of caffeine include: Terba-Mate grown in Paraguay which yields 1.0 to 1.5 percent of caffeine. Cocoa waste from the Gold Coast of Africa, Nigeria, and Brazil which yields 0.2 to 0.7 percent of caffeine. Coffee imported principally from Brazil, Java, India, and Central America which has a caffeine yield of 1.0 to 1.33 percent. Only about 3 percent of the United States supply of coffee is processed to yield caffeine. Tea waste from Critish India and Ceylon yields 3.0 to 3.25 percent caffeine.

Packaging for Transportation and Export

During the earlier years of conserve in kela nuts, a common rackage for transporting the seeds was called the "Uagha". (1) This was made from four strips of flexible wood placed crosswise, fastened at their centers, and then bent into the shape of a horse-shoe with the free ends fastened together to form a framework. The whole was then covered with tanned exhide, filled with fresh kela nuts and covered with a four-ply canvas bag called "gherra" which was securely fastened to the four strips of wood.

Some of the early importations of kola nuts by the Frederick Stearns Company of Detroit, were received in baskets. These were rudely weven of some fibrous material and supplied with a ring or handle made, presumbly, from the bark of Calamus Draco (tai-tai by the natives). The lighter baskets could be carried by the natives on their heads but the heavier ones required two porters who suspended the baskets on a pole passed through the handle.

The basket was first lined with coarse canvas, and then with large succulent leaves called "bal." These leaves, which were obtained from various species of Sterculia and Phrynium ranged in length from 12 to 18 or more inches and from 6 to 10 inches in width. They were reportedly used for packing kola seeds for transportation because they retained their moisture for a long period. Kela seeds were thus protected from the drying effect of the atmosphere without injury for a period of some 50 days. If the nuts were to be preserved in a fresh condition for a longer period, it was necessary to unpack and resort them, wash them in clean running water and repach them in fresh, moist leaves; when, it was claimed, that they could be preserved for a period of from 8 to 10 months.

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Excellent results have been reported from wrapping seeds in dry cotton, then packing them in moist saw-dust in an airtight can. (1) Seeds so packed retained their original color and freshness for ever 3 months and were free from fungi attacks.

Recent reports indicate that kola nuts exported from Jamaica and Central American countries are packed in jute bags, each occupying 4.2 ou. ft. of space, and having a gross weight of 200 pounds and requiring 43 cu. ft. to stow one ten. (10) (14)

West African kela nuts for export are usually packed in bags of varying sizes or in burlap rolls having a gross weight of 600 pounds. (10) Some of the larger bags require 75 cu. ft. to stow one ton of nuts. Records of imports of West African kela nuts into the United States during the past two years have shown bags having a weight somewhat under 200 pounds per bag. (15)

Principal Producing Areas, Volume of Production

No recent data of production by countries is available. In the absence of more recent or authoritative data the following tabulation of world production is reproduced from the work of Chevalier and Perret without attempting to revise the data on the basis of changes in boundaries or names of countries since the book was published in 1911:

Table 3 .- Kola Muts: Estimated World Production

Country	Estima	ted Production
	Letric Tons	Pounds
French Guinea	2,000	4,409,200
Sierra-Leone	2,000	4,409,200
Liberia	1,000	2,204,800
Ivory Coast	3,000	6,613,800
Gold Coast	5,000	11,023,000
Togo	100	220,430
Dahomey	500	1,102,150
Nigeria	2,000	4,409,200
Cameroon	1,400	3,086,440
French Congo	1,000	2,204,600
Portugese Colonies	1,000	2,204,600
Other Countries	1,000	2,204,600
Total	20,000	44,092,000

Chevalier, Aug. et Perrot, Em. Les Kelatiers & Les Noix de Kola, Les Vegetaux Utiles de L'Afrique Tropicale Français, Fascioule VI, Augustin Challamel, Editeur, Rue Jacob, 17 Paris, 1911.

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The botanical classification of these nuts according to the species is:

	Metric tens	Pounds
Cola nitida Cola acuminata	15,000 4.000	33,069,000 8,818,400
Cola Pallayi and others	1,000	2,204,600
Total	20,000	44,042,000

Markets for Kola Nuts

Markets for kela nuts may be roughly divided into the large importing markets of North America and Europe and the principal markets in the producing or exporting areas of Africa, the West Indies and the South American countries.

New York is the principal importing port for kola nuts in North America and consequently the largest distributing center of the North American trade. With the use of kola nuts as a flavoring and stimulant for the large and expanding soft drink industry of the United States, New York is probably now the leading kola nut importing market outside of Africa.

The importance of European markets can only be discussed in terms of the prewar trade. Hamburg, Germany was the principal market for kola nuts among the countries of northwestern Europe and provided the most important market outlet for kola nuts coming from West Africa. The trade in this market was principally in dried nuts in 100 kilogram (220 pound) lots. Liverpool was the principal English market, receiving nuts from Caylon, in 50 kilogram (110 pound) lots, or from Barbados, Grenada or Jamaica in 87 to 100 kilogram lots. Small lots of kola nuts were traded on the market of Antwerp, Belgium, but these quantities were so small as to be of minor significance in world trade. Lisbon, Portugal received fairly large quantities of nuts from Angela, Portuguese Congo and Sao Thome. The principal French ports participating in the kola nut trade were Marseille, Havre, Bordeaux and La Palice.

Dakar is one of the principal distributing centers for kela nuts in French Sudan. The nuts are imported into this market by several European firms for the native frade and also for some of the Syrians having correspondents at Freetown, Sierra-Leone or Conakry, French Guinea. The nuts are usually offered in baskets of 50 kilograms (110 pounds) packed in leaves or separated by layers of ballast. It is particularly in the areas near markets of Dakar, St. Louis, Rufisque, Thies and Podor that consumption of kola nuts is large and tending to expand. There is also considerable trade at these points destined for the interior regions of British Gambie and for the frontier of French Guinea. Considerable quantities of the nuts are sold at retail at Dakar, offered in small quantities of 4 or 5 nuts each.

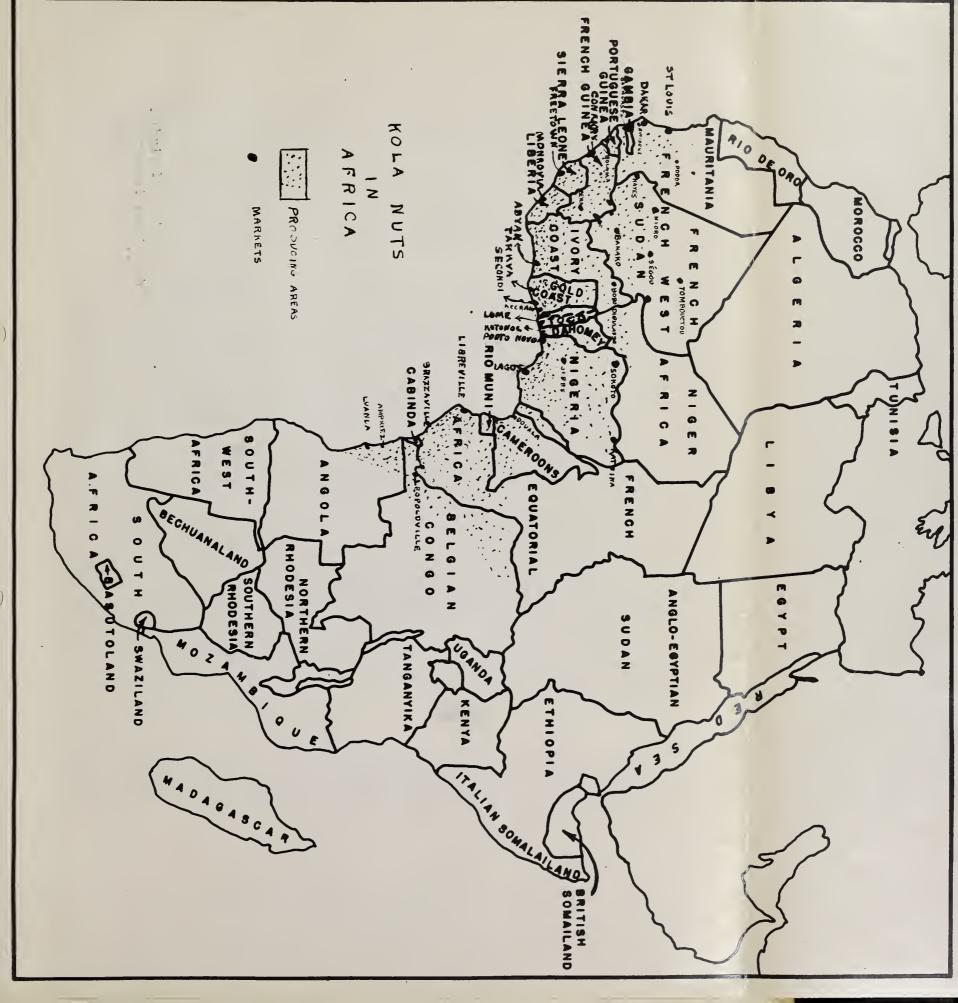
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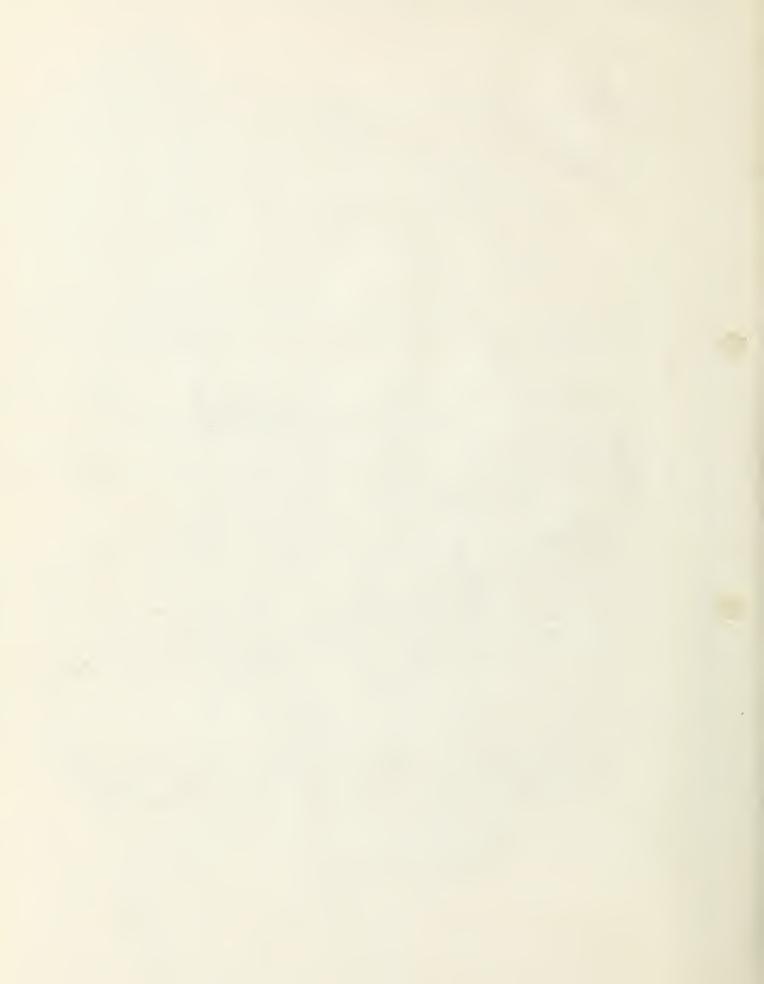
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In the eastern regions of Senegal now included in French Sudan and northern Nigeria the trade in kola nuts moves over 3 principal routes:

- 1. From Sierra-Leone and French Guinea by the river Senegal and the port of Dakar.
- 2. By Siguiri, Kankan and Beyla to the northern sections of French Guinea, Liberia and the northwestern part of the Ivory Coast.
- 3. By Bobo-Dioulasso, Lee or Salaga, to the northern regions of the Gold Coast.

The markets of Kayes and Medine, Banemba and Nioro in the interior districts of French Sudan serve principally as distributing markets for nuts imported into Senegal.

Conakry is a large exporting port of Prench Guinea. It also has an important trade in nuts for shipment up the Senegal River for Portuguese Guinea and by rail to the interior districts northward and eastward.

Morovia is the important exporting port of Liberia. The trade at interior points in Liberia consists mainly of local transactions in small markets rather than through large distributing centers. Among the exporting ports of the western coast of Africa are Abyan of the Ivory Coast, Acera Secondi and Tarkva of the Gold Coast, Lome of Togo, Porte Novo and Kotonoo of Dahomey, and Lagos of Nigeria. Lagos is one of the most important entrepots of the kola nut trade in all of Africa. Tombouctov in French Sudan is the principal terminal market for transhipment of nuts overland to the ports of Morocco for export, while from more eastward regions around Dorn, Niamey, Sokoto and Katseina nuts are transported to Tripoli and Bengazi. Of less importance in the export trade are the coastal cities of the Camaroon, French Equatorial Africa, the Belgian Congo and Angola. These countries, however, have a small export trade and are important sources of shipments from interior districts northward for export or to the large distributing centers supplying interior deficit consuming areas.

Tariffs and Trade Regulations

No import duty is levied on kola nut imports into the United States. The only regulatory measures affecting the kola nut trade in the United States are the War Production Board General Imports Order M-63 (As Amended) and the General Maximum Price Regulation of the Office of Price Administration.

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Under the General Imports Order of the War Production Board M-63, Part 1042 - Imports of Strategetic Materials as amended January 8, 1944, imports of kola nuts since July 2, 1942 have been subject to authorization to import in writing from the War Production Board. Persons desiring such authorization were required to apply to the War Production Board and authorization when granted, unless otherwise expressly permitted, applied only to the particular material and shipments mentioned therein and to the persons and their agents concerned with such shipment and was not assignable or transferrable either in whole or in part.

After importation, unless otherwise provided, kela nuts may be sold, delivered, processed, consumed, purchased, or received without restriction under this order, but all such transactions shall be subject to all applicable provisions of the regulations of the War Production Board which now or hereafter may be in effect with respect to such material.

This regulation also requires that Forms WFB-1040 be filed with all customs entries for the import of these materials and the filing of such other reports, may be required from time to time by the War Production Board.

While kola nuts are technically subject to the maximum price regulation, the control of prices of an import commodity does not begin until the commodity passes from the hands of the original importer. Kela nuts, are practically all utilized by the importer, and, therefore, there has been no regulatory action by the Office of Price Administration regarding prices of kela nuts.

Prices of Kola Nuts

Very few price series are available to indicate the value of kola nuts. In general prices for the cela nitida in European and American markets are higher than for other species or varieties. The following tabulation of prices in the United States will indicate the variations in prices of kela nuts and the designated kela products:

Table 4. Kola nuts and powdered kola nuts: Price, per pound, annual average, 1935-43

Year	Kola Nuts 1/	Powdered Kola Nuts 2/	
	Cents	Cents	
1935	5.75	45.0	
1936	5.75	45.0	
1937	9.75	45.0	
1938	8.00	45.0	
1939	8.75	40.0	
1940	12.50	37.5	
1941	8.50	40.0	
1942	8.75	35.0	
1943	11.25	35.0	
1944 3/	9.50	35.0	

1/ Oil, Faint and Drug Reporter, average of one quotation each week, fresh kola nuts, fob New York in large lots.

2/ National Association of Retail Druggist Journal, average of prices of large wholesale drug houses. Quoted each month.

3/ January-March.

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International Trade in Kola Muts

Statistics of world trade are incomplete but a rough estimate based upon available data suggests that only about 18,000,000 pounds of the kernels or less than half of the estimated commercial production of the world moves into international trade. Of this international trade, it appears that nearly 90 percent is accounted for in the movement among the countries in the western part of Africa. The remaining 10 percent is distributed among the importing countries of North America and Europe.

In a great part of the Sudan, kola nuts, as early as the 12th century, had become an important article of commerce. It is suggested that it was probably trade in this food commodity which stimulated an epoche of prosperity in the 13th century. The trade, however, because more firmly established during the 18th century with the emigration of dealers from the regions now comprising the north central part of French Sudan into the western parts and the formation of groups which even in recent years have been important in the trade in kola nuts in these areas.

Most of the countries of Western Africa have some export trade in kola nuts. Trade along the coastal cities may move into the direct export trade by sea to Europe or North America or to other deficit areas of Africa along the Atlantic Coast. Some of these coastal cities are also importing ports and transshipment points for forwarding shipments into interior districts.

The only series of statistical data available for the African countries are those of the British possessions. Since the Gold Coast and Sierra-Leene are reported to be the two largest experters, data for these countries which form a large chare of the total trade are significant.

Table 5.-Sierra Leone: Exports, kola nuts, 1929-38

Year	1		Quantity	7	-34		: Valu	e total
	: To Gembia		: To hi	geria	: Total	a11	: all	countries
	: Long Yons	:1000	:Long	:1000	: count	ries	:1000	:1000
	fe do	: pound	silors	: pounds		:1000	s È	:dollars
	ĝ	1	8	\$	Tons	: pounds	8	2
1929	683	1,530	1,749	3,918	3,127	7,004	266	1,292
1930	684	1,532	1,319	2,955	2,271	5,087	186	904
1931	630	1,411	810	1,814	1,584	3,548	48	218
1932	840	1,882	1,075	2,408	2,085	4,670	41	144
1933	865	1,938	778	1,743	1,812	4,059	44	186
1934	1,017	2,278	46	103	1,460	3,270	18	91
1935	1,495	3,349	22	49	1,859	4,164	39	191
1936	1,448	3,244	257	576	2,308	5,170	42	209
1937	1,179	2,641	483	1,082	2,248	5,036	61	302
1938	574	1,286	122	273	1,450	3,248	30	147

Statistical Abstract for the British Empire, Trade and Commerce Section

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Table 6 .- Gold Coast of Africa: Exports, kela nuts, 1929-38

Year	8 8	: Sea-borne : trade			: Overland frontiers from : northern territories					
	: Que		:Value		: Quant	ity	:Value	1/		
	Long	1000	1000	1000	Long	1000	1000	1000		
	Tons	pounds		dollars	tons	pounds	£	dollars		
1929	3,056	6,845	127	617	100 APR (100	and and are	40 60 60			
1930	3.768	8,440	138	671	4,650	10,416	mak day out	G1 47499		
1931	1,318	2,952	38	172	380	851	9	41		
1932	355	795	7	25	2,218	4,968	52	182		
1933	249	558	4	17	3,057	6,848	71	301		
1934	159	356	1	5	2,386	5,345	56	282		
1935	249	558	4	20	3,343	7.488	78	382		
1936	429	961	5	25	3,815	8,546	89	442		
1937	497	1,113	4	20	3,711	8,313	87	430		
1938	542	1,214	5	24	3,560	7,974	83	405		

Statistical Abstract for the British Empire, Trade and Commerce Section

The only import series readily available are those of Nigeria and Gambia:
Table 7.- Nigeria: Imports, kela nuts, 1929-38

lear	3	Quantity	8	Value
	Long Tons	1000 pounds	1000 b	1000 dellars
1929	4,531	10,149	342	1,661
1930	4,774	10,694	228	1,109
1931	1,680	3,763	78	354
1932	1,260	2,822	59	207
1933	875	1,960	41	174
1934	56	125	3	15
1935	153	343	7	34
1936	385	862	18	89
1937	505	1,131	23	114
1938	157	352	7	34

Statistical Abstract for the British Empire, Trade and Commerce Section

Table 8.-Gambia: Imports, kola nuts, 1929-38

Year	:	Quantity	; Ve	lue
	Long Tons	1000 pounds	1000 £	1000 dollars
1929	669	1,499	55	267
1930	656	1,469	49	238
1931	598	1,340	19	86
1932	789	1,767	24	84
1933	898	2,012	32	136
1934	1,033	2,314	28	141
1935	1,465	3,282	52	255
1936	1,475	3,304	46	229
1937	1,172	2,625	51	252
1938	580	1,299	22	108

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The import trade for countries outside of Africa appears to be about evenly divided between North America and Europe. Statistics of the European trade, however, are incomplete and the lack of uniformity in the method of reporting imports has made difficult construction of reliable series of data. It is known that kela nuts are imported into Portugal, France, Germany, Belgium and England but no separate classification of these imports are included in the official trade publications for these countries. Some early English data are available from cargo lists which in some instances report imports as kela nuts and in other instances as drugs or greceries.

The United States is the principal importer of North America with only small amounts reported imported into Canada or other North American countries. The following tabulations give import data for the United States, for several recent years:

The increase in United States trade in Jamaican exports is shown in the following tabulation of exports from Jamaica:

Table 11.- Jamaica: Exports, kola nuts, 1929-40

	:	Quantity		\$	
YEAR	: To United	: To United	2	*	VALUE
	: States	: Kingdom	: Total	\$	
	Pounds	Pounds	Pounds	ž	Dollars
1929	124,330	32,311	156,641	2,758	13,395
1930	127,575	26,978	269,808	3,863	18,782
1931	101,191	19,932	221,770	863	3,914
1932	99,684	27,039	187,960	569	1,995
1933	4,301	185,087	436,800	1,664	7,050
1934					
1935	141,138	31,237	241,775	1,002	4,912
1936	227,208	49,344	482,157	2,732	13,581
1937	376,967	13,970	420,264	5,957	29,452
1938	331,860	2,730	389,912	3,024	14,785
1939	345,413	1,383	395,705	3,341	14,819
1940	673,084	987	682,889	8,028	30,747

The West Indies Yearbook (Dominion Colonial and Overseas) New York Agency 120 Broadway. Head Office, London, E.C. 354 Lombard St.

The increase in United States trade in Jamaican exports is shown in the following tabulation of exports from Jamaica:

Table 11 .- Jamaica: Exports, kola nuts, 1929-40

VALUE	3	: Total	Quentity : To United : Kingdom	To United	YEAR
Dollars	4	Pounds	Pounds	Pounds	
13,395	2,758	156,641	32,311	124,330	1929
18,782	3,863	269,808	26,978	127,575	1930
3,914	863	221,770	19,932	161,101	1931
1,895	569	187,960	27,039	99,684	1932
7,050	1,664	436,800	185,087	4,301	1933
					1934
4,912	1,002	241,775	31,237	141,138	1935
13,581	2,732	482,157	49,344	227,208	1936
29,452	5,957	420,264	13,970	376,967	1937
14,785	3,024	389,912	2,730	331,860	1938
14,819	3,341	395,705	1,383	345,413	1939
30,747	8\$0.8	682,889	987	673,084	1940

The West Indies Yearbook (Dominion Colonial and Overseas) New York Agency 120 Broadway. Head Office, London, E.C. 354 Lombard St.

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